IM1000

INSTALLATION MANUAL

Marine Generators | Marine Diesel Engines | Land-Based Generators

NORTHERN LIGHTS®

LUGGER

— CALIFORNIA —
Proposition 65 Warning:

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

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NORTHERN LIGHTS®

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MARINE GENERATOR INSTALLATION MANUAL

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Read this manual thoroughly before starting to install your equipment.

This manual contains information you will need to do the job correctly and safely.

This manual will explain installation procedures for Northern Lights marine generator sets. The instructions are general in nature and intended to be used only as guidelines. If you have questions, please contact your local dealer or factory office.

The installation of a marine generator is a complex task that requires special tools and knowledge. Northern Lights strongly recommends that this work be performed by a qualified dealer or boatyard. For the safety of the set, the vessel and all those aboard, owner installations must be reviewed by a qualified inspector.

Proper planning is essential for a successful installation. You will find all necessary measurements on the dimensional drawings available from your Northern Lights dealer. Be sure to use current drawings, since the sets are continuously being improved. Plan your installation so the inspections and service work outlined in your owner's manual can be easily performed.

Use only quality marine grade materials throughout the installation. Follow all safety precautions. Areas of special concern are: mounting the set, ventilation, supply and discharge of cooling water, exhaust discharge, fuel lines, electrical wiring, system bonding and service access.

Under no circumstances are Northern Lights diesel powered gen sets or Lugger marine diesel engines, or any other diesel powered equipment provided by Alaska Diesel Electric, Inc. to be installed or used in any vessel in which a gasoline engine is also present. Northern Lights and Lugger products do not include spark-arresting and explosion-proof electrical components necessary to operate in the presence of gasoline or gasoline fumes.

The installation of Northern Lights and Lugger products in vessels that also include gasoline powered engines is not authorized by Alaska Diesel Electric, Inc. or any Northern Lights or Lugger dealer, distributor, or agent.

Northern Lights reserves the right to make product improvements and changes at any time without notice.

NORTHERN LIGHTS®

Model Numbers

Model numbers give the unit's application, block model, aspiration, and RPM:

L, M, NL

L - Northern Lights propulsion engine (Lugger)
M - Northern Lights marine generator set
NL - Northern Lights industrial generator set

673

Model number of base engine block

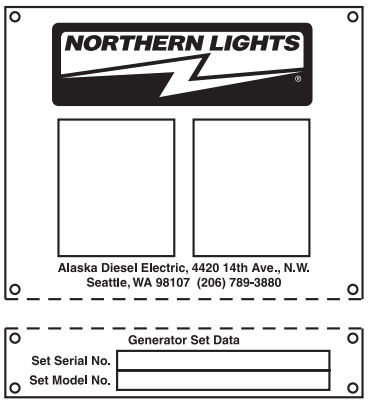
D, T, A, L, W, H

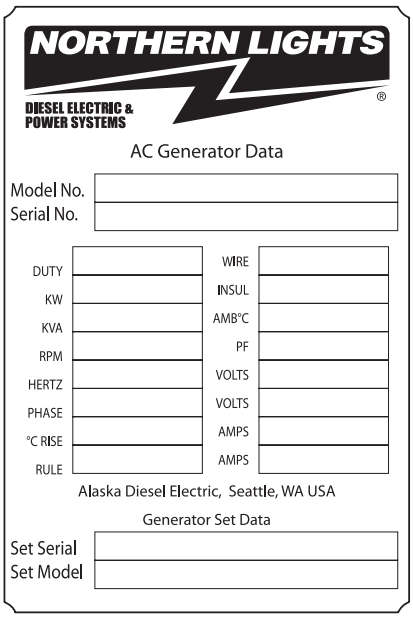
D = Naturally Aspirated
T = Turbocharged
A = Aftercooled & Turbo
L = Long Stroke
W = Auxiliary Winding in Gen End
H = High Output

For example: **M** 673 — Northern Lights marine generator set with a 673 engine.

Serial Numbers

- When referencing Northern Lights equipment by serial number, it is important to differentiate between (1) the engine, (2) the generator end, and (3) the generator set serial numbers.
- The engine serial number is either on a metal tag or stamped directly into the engine block.
- The generator END serial number is on a metal tag attached to the generator end.
- The generator SET serial number is on a separate metal tag attached to the generator end. It may be a five by one inch tag installed directly below the generator end tag (lower left). Or, it may look like the examples on the right. Please use the generator SET model and serial numbers in correspondence or when ordering parts.





Warranty

A warranty registration certificate is supplied with your set. It entitles the original purchaser of our equipment to a warranty covering material or assembly faults. The extent of coverage is described in the Limited Warranty Statement (L581). We recommend that you study the statement carefully. If the warranty is to apply, the installation instructions outlined in this manual must be followed. If further information is needed, please contact an authorized dealer or the factory.

Safety Rules

Accident reports show that careless use of engines causes a high percentage of accidents. You can avoid accidents by observing these safety rules. Study these rules carefully and follow them on the job.

- Turn the coolant tank cap slowly to relieve pressure before removing. Add coolant only when the engine is stopped and cool.
- Mount fire extinguisher near engine.
- Always disconnect the battery ground strap before making adjustments.
- Operate engine in properly ventilated areas.
- Keep trash and other objects away from engine.
- Escaping fluids under pressure can penetrate your skin. Use a piece of cardboard or wood, not your hands, to search for fuel leaks.
- Avoid wearing loose clothing without a belt when working around engines.
- Do not oil or grease engine while it is running.
- Use caution in handling fuel. Never re-fuel a hot or running engine. Do not smoke while filling fuel tank or servicing fuel system.
- Keep your hands, feet, hair and clothing away from power-driven parts.
- Check for any loose electrical connections or faulty wiring.
- Engines should be operated only by knowledgeable, qualified personnel.
- Walk completely around engine to make sure that everything is clear before starting it up.
- Do not operate an engine that isn't in proper working order. If an unsafe operating condition is noted, tag the engine so others will also know about it.
- Provide first aid kits.

Do's and Don'ts

DO:

- Use siphon break on sets near waterline (see page 8).
- Use raw water strainer on intake.
- Use primary water separator fuel filter.
- Use grommets on wire openings in junction box.
- Use protective circuit breakers.
- Use good bonding system.
- Balance load on generator legs.
- Use gravity feed fuel filter wherever possible.
- Install so engine service side is easily accessible.
- Allow easy access to expansion tank.
- Mount wet muffler lower than the exhaust manifold.
- Install the unit so the crankshaft is parallel to the vessel's center line.

DON'T:

- Use scoop type water inlet through hull fittings. At high speeds, scoops pick up water which is forced past the impeller in the raw water pump. Water will fill the cylinders and ruin the engine.
- Put seasonal load on one leg of generator (heaters). Split loads between legs.

Model Selection

Northern Lights produces marine and land-based generator sets that operate at 1500 and 1800 RPM with ratings from 4.5 kW to 280 kW.

With this broad range of sets to choose from, it is often difficult to determine which is right for your vessel. Begin the selection process by estimating the electrical load.

After that, you can customize the chosen set to match your vessel's needs. Modifications include single phase or three phase, 50 cycle output, heat exchanger or keel cooling, wet or dry exhaust and 12 or 24 volt starting systems.

Estimating Electrical Load

It is important to match the correct Northern Lights generator with your vessel's electrical load. The right generator is determined by the total wattage of all the equipment and appliances which will be operated simultaneously. Selecting a generator that is too small for the peak load can make it hard to start motors in air conditioners or water makers, for example. Selecting too large a generator causes the engine to operate in an overly cool condition which causes injector and valve carboning, and the pumping of raw fuel into the exhaust.

The wattage required for any given piece of equipment is usually printed on the name plate. If only the amp rating is listed, multiply amps x voltage to get the equipment wattage. If there is no data plate, or if the information is not supplied on the data plate, call your dealer for typical wattage requirements of some motors and appliances. Motors and other loads require several times full load current under starting conditions. If the motor starting load is large, a voltage dip may cause the lights to dim or relays to chatter.

A good rule of thumb is that the continuous load should be at least 50% of the generator capacity. It may be advantageous to use two smaller sets.

Circuit Breakers

An AC circuit breaker should be installed on all Northern Lights generators to protect the generator windings in case of a short circuit or an overload due to unbalanced load conditions.

Balancing Loads

All loads which will be used at the same time must be divided up equally among the output legs. For example, don't put heating loads on one leg and air conditioning loads on the other leg. Improperly balanced loads may cause a loss in voltage on the loaded leg and excessive voltage on the unloaded leg as well as low output. Since the engine is not affected by an unbalanced overload it is possible to damage the generator.

Motor Loads

Electric motors and appliances containing electric motors usually require up to ten times the running wattage during starting. A good rule of thumb when working with motor loads is to take the running wattage of the largest motor and multiply that by ten. Then add the running wattage of all the smaller motors, as well as the wattage of all the other loads. This will add up to your total load.

Determine how much of the total load will be operating at the same time. If a motor can be wired up at several voltages (for example, 120 volts or 240 volts) it is usually more efficient to wire it at the higher voltage.

Some devices utilizing non-linear loads (SCR devices) may cause a distortion in the waveform of the generator's electric output. This can lead to the malfunction of the voltage regulator and overheating of the generator rotor. Consult the factory for specifics pertaining to your generator set.

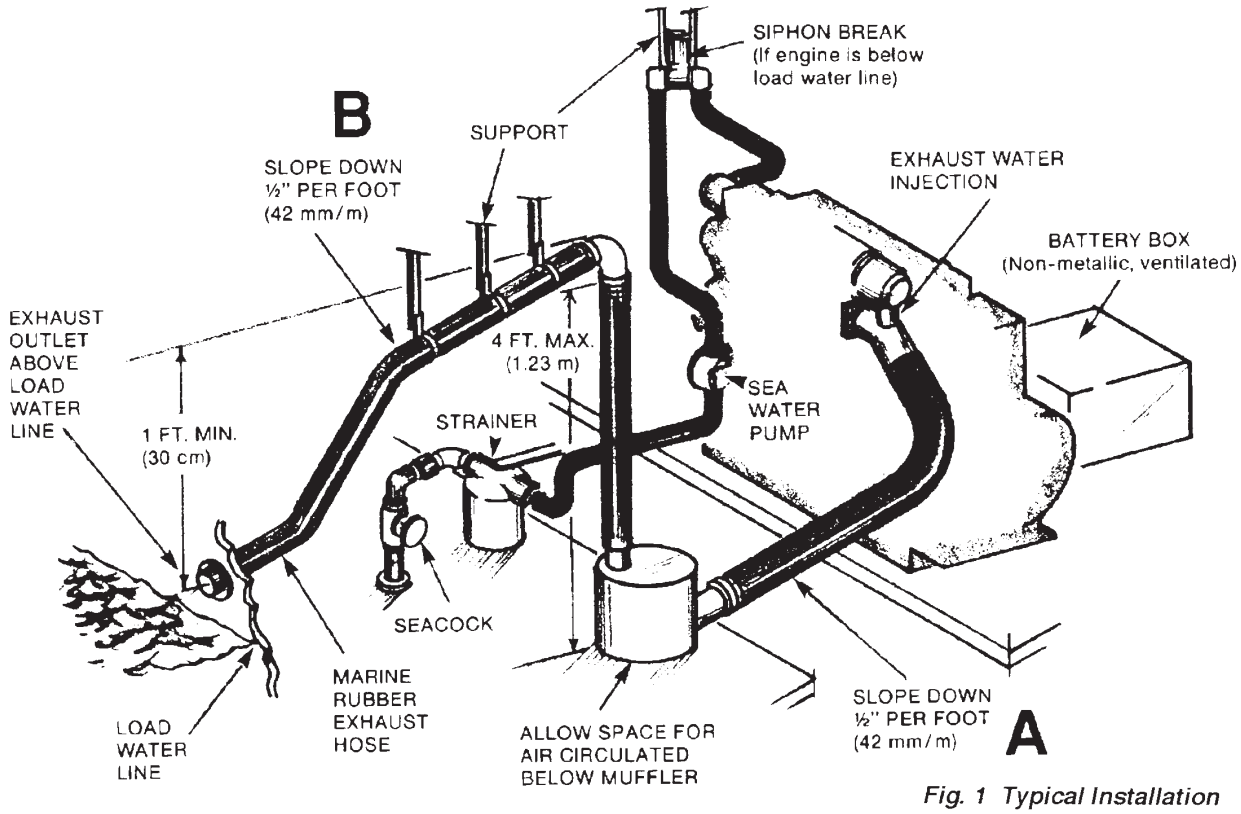


Fig. 1 Typical Installation

The two main elements that decide where a generator should be located are ① the availability of space, and ② the adequacy of structural support. Thought should be given to ventilation, cooling and exhaust systems as well, and these areas will be covered later.

The generator is usually located in the engine room, where there is already plenty of ventilation. The main engine stringers can be used as supports. If the generator set cannot be located in the same compartment as the propulsion engine, it should be in a properly ventilated compartment isolated from the living quarters.

Generator set location should provide easy access for regular maintenance and fuel system adjustment. Bear in mind that the generator set will require replacement of worn parts and eventual overhaul. The control panel should be located so it can be easily monitored during generator operation. For ease of servicing, make sure that the sea cock and the inlet water strainer are completely accessible.

Northern Lights generators are supported on a frame that incorporates a drip pan and is equipped with vibration isolation mounts. A rigid mounting base must be used to mount the set to the engine stringers, or other strong supports. This rigid base anchors the set and prevents noise transmission through the boat frame. The mounting base can be either metal or wood. A thicker and more rigid base will cut down on the drum-like tendency of the drip pan to magnify engine noise.

It is important to use marine grade plywood or lumber; make sure that the generator base supports the complete underside of the drip pan. Be sure that the base does not touch any of the bulkheads or free board, which will amplify noise transmission from the engine. Mount the generator away from bilge splash and low-lying vapors.

Because flexible mounts are used, the generator will rock during engine operation in rough seas. Therefore, you must plan for adequate clearance on all sides. Use flexible connections on all lines and connections.

Dimensions, weights, and maximum operating angularity vary by model and are available from Northern Lights.

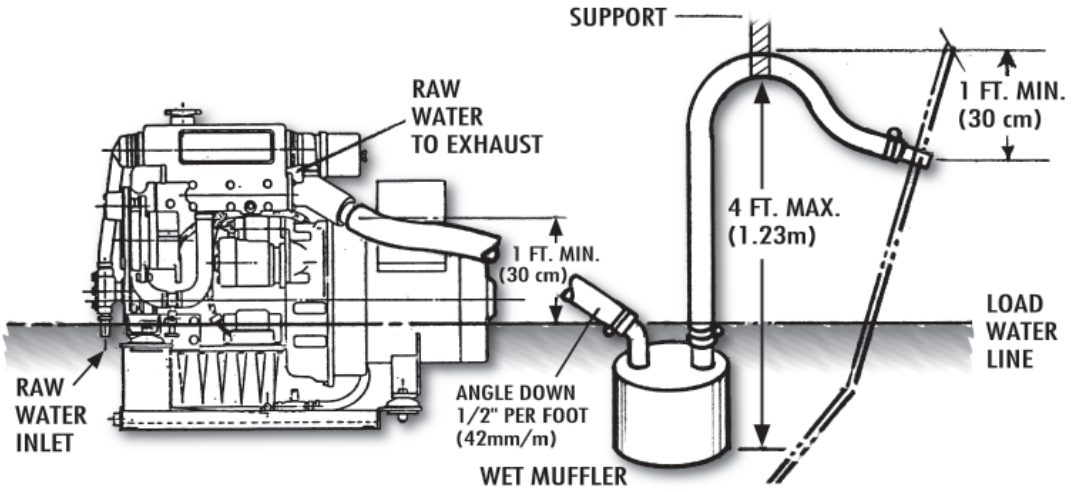


Figure 2: Exhaust Manifold ABOVE Load Water Line

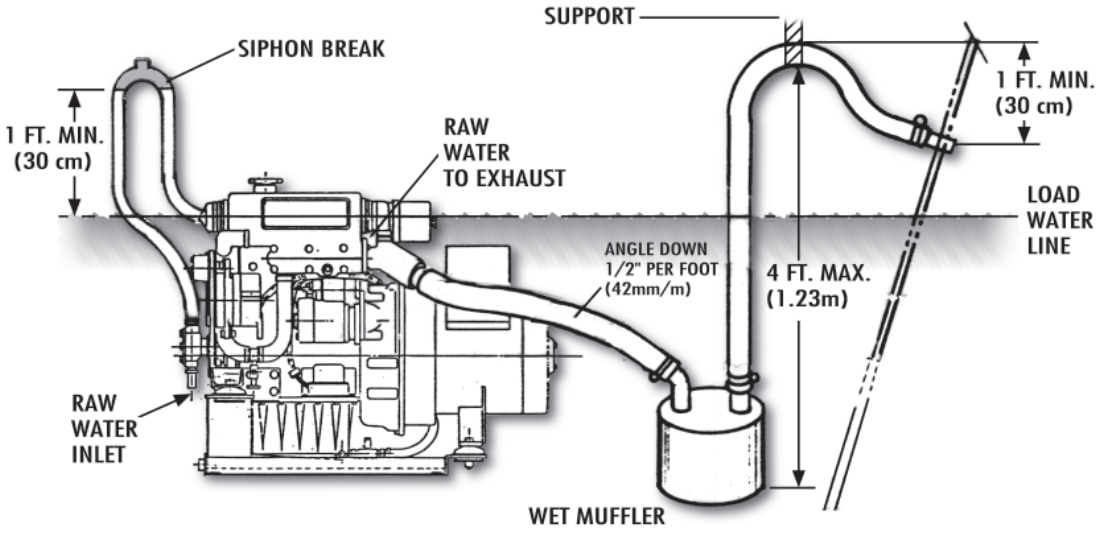


Figure 3: Exhaust Manifold AT Load Water Line

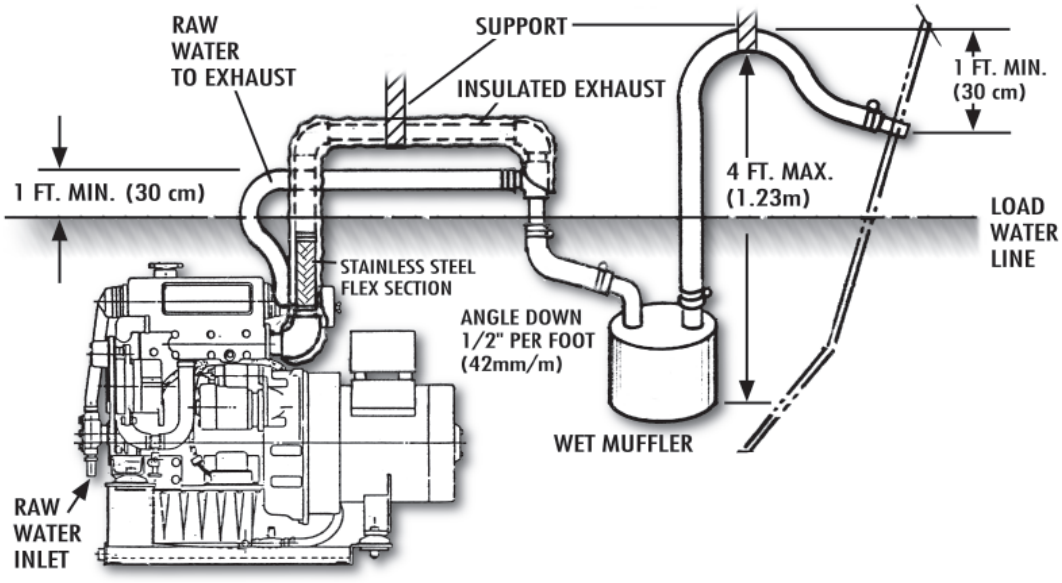


Figure 4: Exhaust Manifold BELOW Load Water Line

GENERAL

There are two basic types of exhaust systems used in marine generator set installations:

A) Wet Exhaust - the exhaust gases are cooled by the addition of water from the engine cooling system at some point along the exhaust system. The exact point at which the water joins the exhaust gases depends on whether the engine is mounted above or below the water line.

B) Dry Exhaust - the exhaust gases are not mixed with the water. The exhaust system is completely dry, and also very hot. All pipe work must be insulated.

WET EXHAUST

Advantages: less fire risk; the amount of heat given off in the vessel is less; it is very quiet.

WARNING: *Extreme care must be taken during installation to prevent backflow of water into the engine under any conditions. Water flowing back to the engine will damage it and possibly flood the boat. The exhaust outlet must be above the load water line.*
On sailboats, provisions must be made to prevent the exhaust exit from being below the water line in any running angle, especially during tacking or heeling maneuvers. A transom location is best.

WATERLIFT EXHAUST SYSTEMS

The waterlift exhaust system is a simple, inexpensive method of exhausting engine exhaust in raw water from the cooling system. The waterlift muffler is a cannister with an inlet and an outlet, the outlet pipe extends inside the cannister almost to its bottom.

The engine cooling water is injected into the exhaust line near the exhaust manifold. Water from the wet exhaust fills the cannister above the bottom line of the outlet pipe, effectively blocking the outlet. When sufficient pressure builds up, the water and exhaust gases are literally “blown” out of the submerged outlet pipe, and the cycle begins again. Boats equipped with water-lift systems are easily identified by the bursts of cooling water from their exhaust pipe.

The water should be injected into the exhaust system as close to the exhaust manifold as is possible. All Northern Lights generators can be supplied with water injection elbows which attach directly to the wet exhaust manifold. Rubber hose designed and approved for marine exhaust line use can be used for the point of water injection. Any piping before the point of water injection must be water jacketed or insulated to minimize heat rejection and fire risk.

Flexible rubber exhaust hose allows for easy installation and flexibility. The exhaust line should be at least as large as the engine exhaust outlet. The line should be increased one pipe size for each ten feet (3.048 m) in length. The waterlift muffler should be mounted below the exhaust manifold. The exhaust line should pitch downward at least one-half inch per foot (or 42 mm/m) of line from the point of water injection to the muffler. Do not connect the muffler directly to the exhaust manifold (see Figure 2).

On heat exchanger cooled units, the raw water flow can be injected into the exhaust system. On keel cooled units, a separate raw water pump will be required to inject water into the exhaust.

The outlet line from the waterlift muffler should loop at least 12" (30 cm) above the water line. Avoid any low spots or belly in the hose where water can be trapped and flow back into the engine when the boat pitches and rolls. The highest point of the loop should be no more than four feet (1.23 m) measured from the bottom of the muffler.

WARNING: *If the point of water injection cannot be located at least 12" (30 cm) above the water line, a SIPHON BREAK will be required to prevent siphoning the exhaust water back into the exhaust system.*

If a siphon break is used, it should be located between the raw water pump and the inlet to the heat exchanger. This will allow positive closure of the valve in the siphon break during engine operation. The siphon break should be located at least 12" (30 cm) above the water line (see Figure 3). DO NOT use a drip tube on the siphon break as it will negate the function of the valve.

If the exhaust manifold is significantly below the water line, causing a rise of greater than 4 feet (1.23 m), an insulated dry stack arrangement can be used to raise the waterlift muffler above the exhaust manifold (see Figure 4). The uncooled portion of the exhaust piping must be insulated.

The distance from the top of the loop to the thru-hull fitting should be a drop of 12" (30 cm) minimum, sloping at least one-half inch per foot (42 mm/m) of distance. This will prevent backflow of water into the exhaust manifold due to pitching of the vessel. Remember, four feet is the maximum allowable vertical lift between the muffler and the top of the exhaust loop. Pipe hangers should be used to support the tubing and prevent dips or pockets which allow water to build up in low sections of the line. This causes back pressure and increases the noise level.

High exhaust temperature shutdown or alarm switches are available options and are required on wet exhaust systems used with keel cooled engines.

WARNING: *Scoop type water inlet fittings must not be used. They allow water to push up past the raw water pump when the generator is not in operation while cruising, and this allows water to fill up the muffler. With no exhaust pressure to force the water out of the muffler, the water backs up into the exhaust manifold and into the cylinders.*

WARNING: *If the engine is cranked for a considerable period of time without firing, raw water can fill up the muffler and back up into the exhaust manifolds due to lack of exhaust pressure to evacuate the muffler.*

If the engine must be cranked for more than one minute at a time without starting (for example, to bleed the fuel system), close the seacock and remove the raw water pump impeller until the engine can be started. Then stop the engine immediately, replace the impeller and open the seacock.

The exhaust water piping should be isolated and not connected to the exhaust piping of any other engine. The installed exhaust system should not create exhaust back pressure greater than 30" (760 mm) of water for a turbocharged engine and 48" (1200 mm) for a non-turbocharged unit, measured at the engine exhaust elbow. The exhaust outlet must be located as close to the outboard side of the transom to minimize exhaust gases being drawn onboard the vessel. The exhaust outlet should not be located near hatches or portholes and must be above the water line.

DRY EXHAUST

Because of the high temperatures involved in a dry exhaust system, each part of the system must be well insulated from any combustible surface and equipped with guards to prevent burns.

Dry exhaust shall not come in direct contact with bulkheads or other combustible materials. A clearance of 9" (23 cm) must be maintained between the exhaust and any combustible material, unless protected by suitable insulation.

The insulating material must be suitable for the temperatures involved, and thick enough to prevent the surface of the insulation from reaching a temperature above 71° C (160° F). The exhaust system must be piped so that air circulates freely around it.

Water must be prevented from entering the engine through the exhaust. Provision must be made for drawing off rain water entering the silencer, or putting a tee connection in the exhaust pipe.

The exhaust pipe between the manifold and the silencer should be water jacketed but may be dry if adequately shielded or covered to prevent burns. A flexible connection must be used between the engine and the exhaust piping. Exhaust piping, silencers and other parts of the system must be supported through the length of the system. It is important that the engine exhaust elbow does not support ***any*** weight of the exhaust system.

KEEL COOLING OR SKIN COOLING

Keel cooling or skin cooling is a closed circuit method of cooling that uses only fresh water. Engine heat is dissipated by passing coolant through tubes fitted to the outside of the hull (keel cooling), or incorporated as part of the hull (skin cooling). Keel coolers protrude from the bottom of the boat. The engine circulating water pump is the only pump necessary.

The size and length of the tubes is determined by the horsepower and water flow of the engine. When sizing keel coolers for generator sets, they must be larger than those for an equivalent propulsion unit because the generator set normally sees maximum load while the boat is at rest when no water flows past the coolers. Do not combine the keel cooler for the generator set with the keel cooler for any other engine on the vessel.

If a wet exhaust is desired on a keel cooled or a skin cooled unit, a separate pump is required to draw raw water from a thru-hull fitting into the exhaust. A high exhaust temperature switch is also required.

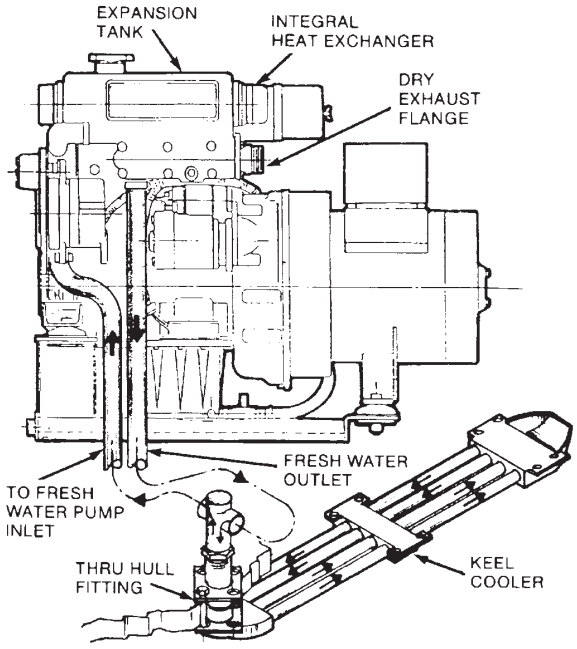


Figure 5: Keel Cooling

HEAT EXCHANGER COOLING

In a cooling system with a heat exchanger, and with thermostats closed, a fixed amount of fresh water circulates through the engine's cooling loop. When the thermostats are open, the coolant is directed through the heat exchanger. It is cooled by raw water that is pumped in by way of a thru-hull fitting, sea cock and strainer, then through the heat exchanger, and directed overboard through a wet exhaust or another thru-hull fitting.

Scoop type inlet fittings must not be used because they can cause water to be forced up into the raw water system when the generator is not in operation if the vessel is underway. The waterlift muffler will flood and fill up the exhaust manifold with water.

The sizing of the thru-hull fitting, the sea cock and the strainer should be no smaller than the inlet to the raw water pump. For raw water pump inlet sizing, please see the appropriate installation drawing or call your dealer.

The raw water pump is a neoprene impeller type pump, which provides a positive suction lift of up to 39" (1 m). The thru-hull inlet fitting should be a flush type, located beneath the water level during operation. The inlet water strainer keeps most debris from reaching the raw water pump where it could break the impeller or clog the heat exchanger.

Closing the sea cock enables the owner to clean the sea strainer. The raw water pump impeller is a maintenance item and easy access must be provided. Make sure to provide easy access to the zinc(s) located in the heat exchanger. If the fresh water pump is belt driven, access must be available for belt replacement.

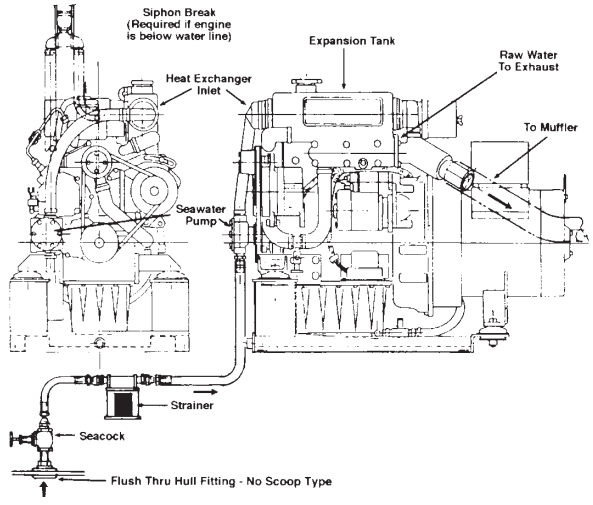


Figure 6: Heat Exchanger Cooling

Fuel System

Extreme care is required in the design and installation of fuel systems. Fuel leakage presents a fire and explosion hazard. Follow U.S.C.G. codes and use only components that are specified for marine applications.

Each Northern Lights generator has a fuel manifold with connections for supply and returned fuel. The lines should be no smaller than these pipe sizes. Pipe sizes can be found on the installation drawing.

Fuel lines must have as few connections as possible. The line should be routed where they are protected from damage and vibration. They should be clamped securely about every 15" (58 cm). Metal fuel lines should be bonded to the common bonding conductor. Fuel lines must be kept away from hot engine or exhaust areas.

Fuel should be drawn from the top of the tank and run at tank level as close to the engine as possible. If a line breaks, this will reduce the danger of fuel siphoning. The fuel pick-up tube should not draw fuel directly from the bottom of the tank but should be located 1 to 2 inches from the bottom and cut off diagonally. The tank must be suitably vented. Metal tanks must be properly bonded. The bonding strap should be connected from the fuel fill to the fuel tank if a rubber connection is used. A water separator type filter should be used between the tank and the generator set and located as close to the generator as possible.

To comply with U.S.C.G. regulations for boats for hire, a shut-off valve must be installed at the tank connection to stop fuel flow. An electric or manual valve can be used. Electric valves should be energized only when the engine control switch is in the run position. Valves must have a manual override. If a manual valve is used, provisions must be made to operate it from outside the compartment where the tanks are located, preferably from above the deck.

If the engine and fuel tank are separated by more than 12 feet (3.7 m), a Coast Guard approved shutoff valve must be installed at the engine. This valve makes it easy to change the filters without draining the entire fuel line and allows for easier engine servicing. If the fuel tank is located above the engine, provision should be made to shut off the fuel when the engine is not running and for servicing of the filters.

If the fuel tank is located below the engine, there is a maximum lift of 39 inches (1 m) on the suction side of the lift pump. Long runs of piping with multiple connections and vertical looping create many points at which air can be trapped or sucked into the system. Air can hamper engine performance and create starting problems. The fuel lines should not be teed into the fuel lines of any other engine. The supply pump on the generator does not have the power nor the capacity to overcome the draw of the propulsion engines.

When lines are teed or joined at a common manifold, air will be drawn into the fuel system if there is a leak at any point, including at the propulsion engine. Air will be drawn into the fuel system, which causes low power, hard starting or generator engine shut down.

Due to the high return fuel rate of many propulsion engines, it is common for air problems to show up in the generator before it shows up in the propulsion engine. Every effort must be made to prevent air from being drawn into the system at any point.

If a lift of more than 39 inches (1 m) is required, a pump and float tank arrangement can be employed. The pump should be energized only when the generator control switch is in the run position.

Ventilation

Besides providing adequate air for engine combustion, the generator end requires cooling ventilation. The ventilation requirements for each generator set is available from Northern Lights.

Normally, the generator set is located in the same compartment as the main engine. Because the generator is usually small in relation to the main engine, the ventilation is adequate. If the generator set is located in a separate compartment, it is important that adequate ventilation is provided while the vessel is both underway and not moving.

Vents must be located so moisture is not ducted into the generators. The vents should be protected so that water is not drawn into the generator during washdown.

Make sure that no moisture or contamination from the bilge can be drawn up into the generator itself.

Noise Control

In a boat, noise is transmitted two ways, through the air or through the hull. Proper installation can control noise from both sources. Northern Lights generators have rubber isolation mounts which connect the unit to a rigid base frame. The frame contains an integral drip pan.

By using a solid piece of plywood under the whole base frame, the drum effect of vibration on the drip pan can be eliminated. The thicker and more rigid the mounting base, the lower the transmission of noise. Mount the generator on as rigid a base as possible. Avoid using light stringers or bulkheads that can vibrate and amplify noise. Be sure the generator does not touch bulkheads, the hull or other structures. Be sure that all fuel lines connected to the generator are secured and contain flexible connections to the generator.

Some of the units larger than 20 kW can be fitted with isolation mounts, which increase the isolation of the unit and cut down the transmission of vibration.

Noise transmission through the air can be caused by intake air noise, exhaust noise and noise radiated from the generator and engine.

Intake noise is controlled in Northern Lights generators by using special air intake housings. Many competitive generators use only intake screens which offer no silencing. Be sure to service the air filter properly and replace it with the correct type.

Exhaust noise can be limited by use of water lift type mufflers and flexible exhaust hose. Be sure that any sections of hard exhaust tubing are not rigidly mounted to bulkheads or the hull. Use a flexible connection to the transom.

Many Northern Lights sets can be mounted in an optional sound shield to reduce noise. It provides easy access for service and can be quickly disassembled for repairs. A separate installation booklet is supplied with the sound shield. The engine room itself can be lined with insulating material which reduces noise transmission to other parts of the vessel.

DC Electrical System

Northern Lights generators 20 kW and below are provided with a Series 1-B control panel as standard equipment. The panel consists of an hour meter, a double pole double throw start/stop switch and a single pole momentary contact preheat/bypass switch. The preheat/bypass switch operates any preheaters and bypasses the safety shutdown system for starting. There is a light in the start/stop switch which indicates that the generator is operating. The panel is designed for remote mounting and is connected to the generator by a plug-type connector. The unit comes standard with a 20 ft. (6 m) harness. 10, 20, and 40 foot (3, 6, and 12 m) harness extensions are optional.

Units larger than 20 kW come standard with the Series 3 panel. The panel is provided with a plug-in or, on some models, a terminal strip that must be hardwired by the installer to the terminal strip on the generator. This panel includes the stop/start switch, preheat/bypass switch, hour meter, DC volt meter, oil pressure gauge and water temperature gauge.

Optional Series 4 panels include all items listed for the Series 3 as well as an AC volt meter, AC ammeter, amp meter selector switch and a frequency meter. The DC control and meter connections are the same as the Series 3 panel. A terminal strip is provided in the Series 4 control panel and in the junction box of the generator for the installer to hardwire the AC connections. Current transformers must also be installed on the generator output leads.

Series 1, Series 3 and Series 4 panels can be used together in multi-panel systems. Some combinations can be made without modification by using “Y” connectors. Others require dual senders or other modifications. See your dealer for information on the panel combination you want to use.

The DC electrical drawings in the operator's manual show the required wire sizes. Panels can be installed up to 40' (12 m) from the generator. For runs longer than 40', contact your dealer or factory office for information.

Batteries

Northern Lights generators utilize negative ground electrical systems. The negative (-) terminal of the battery should be connected to the cap screw on the bell housing near the starter. In the case of a “floating ground”, however, do not connect the negative (-) terminal to the engine block. Instead, connect it to the grounding post provided. The positive (+) terminal should always be connected to the starter solenoid terminal marked “positive”.

Always use batteries at least as large as those listed in the specification section at the end of this manual. The specifications also list recommended wire sizes and maximum distances that the batteries can be located from the engine.

The generator should not be operated off the propulsion engine's starting batteries. Dedicated generator batteries should be used. This prevents unintended discharge of the propulsion engine batteries as well as providing an extra set of batteries onboard should the need arise. When providing a separate set of batteries, be sure to include a shore powered charging system for the generator batteries.

Secure the batteries in an acid resistant container on a platform above the floor. Use a nonmetallic cover to prevent damage or sparks. Generator batteries should be installed as close to the unit as possible but not directly under the generator.

WARNING: *Be sure to allow plenty of ventilation to prevent the accumulation of explosive hydrogen gas generated during battery charging.*

United States Coast Guard regulation 33 CFR-183 requires that the generator be grounded and that a common conductor be connected between the generator set grounded starter motor circuit and the vessel's main propulsion engine grounded starter motor circuit. This conductor or common ground prevents the accidental passage of cranking current through the fuel system and small electrical conductors common to both engines. This conductor should be the same size as the largest battery cable.

AC Electrical System

Due to the possibility of fire and shock hazards, it is important that a qualified electrician installs and inspects the boat wiring. All wiring must meet Coast Guard, NFPA and any other applicable codes.

A circuit breaker should be installed as close to the generator as possible. Flexible wiring should be used between the generator connections and the circuit breaker. Most builders use flexible multi-strand wire throughout the boat to minimize breakage due to vibration.

The electrical distribution system must be designed in such a way that individual circuits cannot be energized by more than one source of electrical power at a time. Each shore power connection or generator is a separate source of electrical power and transfer between sources should be made with a switch that has arc-over protection between the contacts.

There is no consensus of opinion on whether the neutral conductor should be connected to the bonding system (grounded) or not (floating ground). Grounding the neutral may increase electrolytic corrosion. Not grounding the neutral creates a potential shock hazard. The American Boat and Yacht Council recommends grounding the neutral at the generator for safety reasons, though this may shorten the life of heat exchangers and other components. Northern Lights heartily recommends grounding the neutral since personal safety takes priority over all other considerations.

For additional electrical information, consult the AC wiring diagrams in the Generator Manual for the generator end installed on your set.

Notes

Notes

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